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Mendiratta et al.

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(54) **COMMUNICATION FAILOVER IN A DISTRIBUTED NETWORK**

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(51) **Int. Cl.**

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H04L 12/24	(2006.01)
G06F 11/20	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 41/0668*** (2013.01); ***G06F 11/2002*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 11/2002; G06F 11/2005; G06F 11/2028; G06F 11/2033

USPC 714/4.11

See application file for complete search history.

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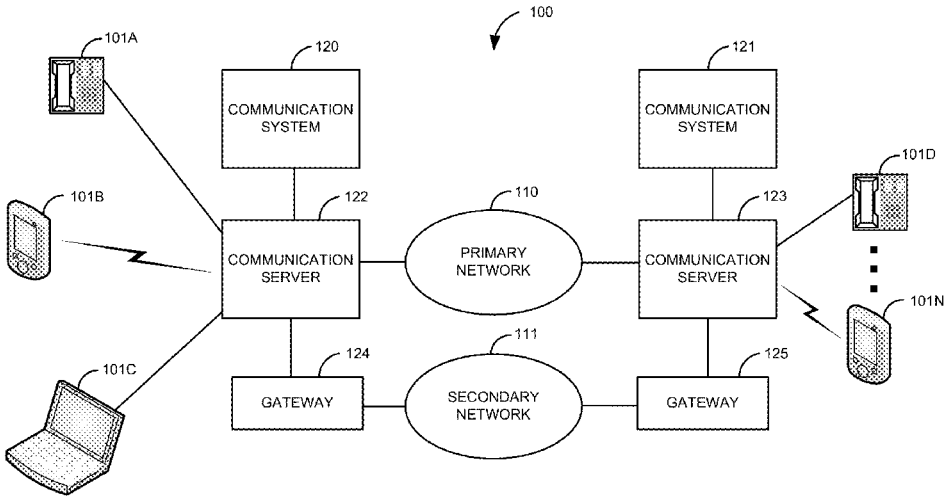
(57) **ABSTRACT**

An initial request is received to establish a communication session. The initial request contains a communication address of a first communication device. A communication server detects that the communication session cannot be established across a primary network. In response, the initial request is repurposed by changing the first communication address to a second communication address. The changed request is sent to a communication system, which adds a field to the changed request that indicates that the changed request is to be sent via a secondary network. The changed request is sent with the field to the communication server. The changed request with the second communication address is sent to a gateway to establish the communication session across a secondary network. A portion of the communication session is established using the second communication address. The first communication address is sent in the portion of the communication session using Dual-Tone-Multi-Frequency (DTMF).

20 Claims, 3 Drawing Sheets



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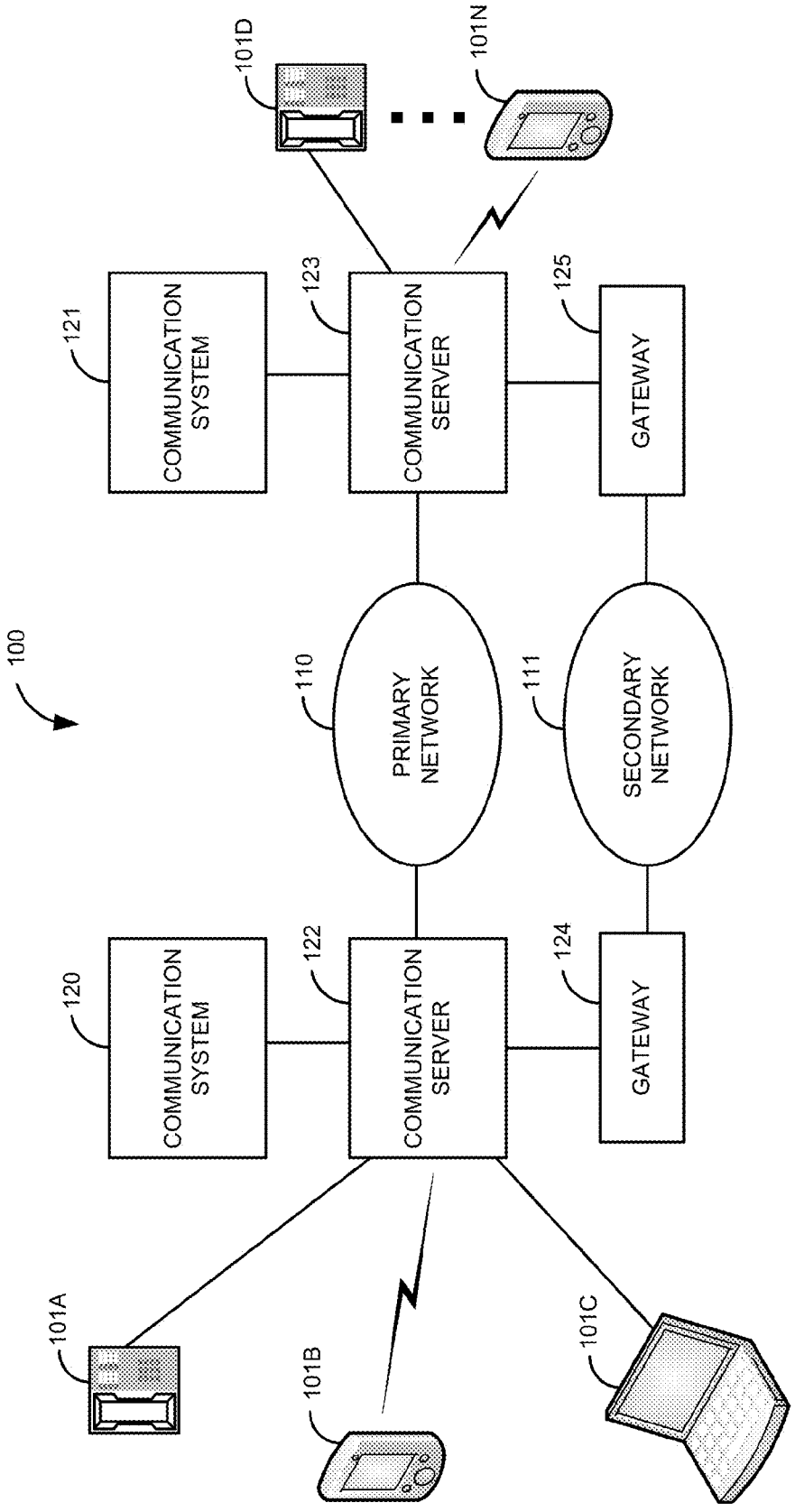
100
101A
101B
101C
101D
101N
110
PRIMARY NETWORK
111
SECONDARY NETWORK
120
COMMUNICATION SYSTEM
121
COMMUNICATION SYSTEM
122
COMMUNICATION SERVER
123
COMMUNICATION SERVER
124
GATEWAY
125
GATEWAY

FIG. 1

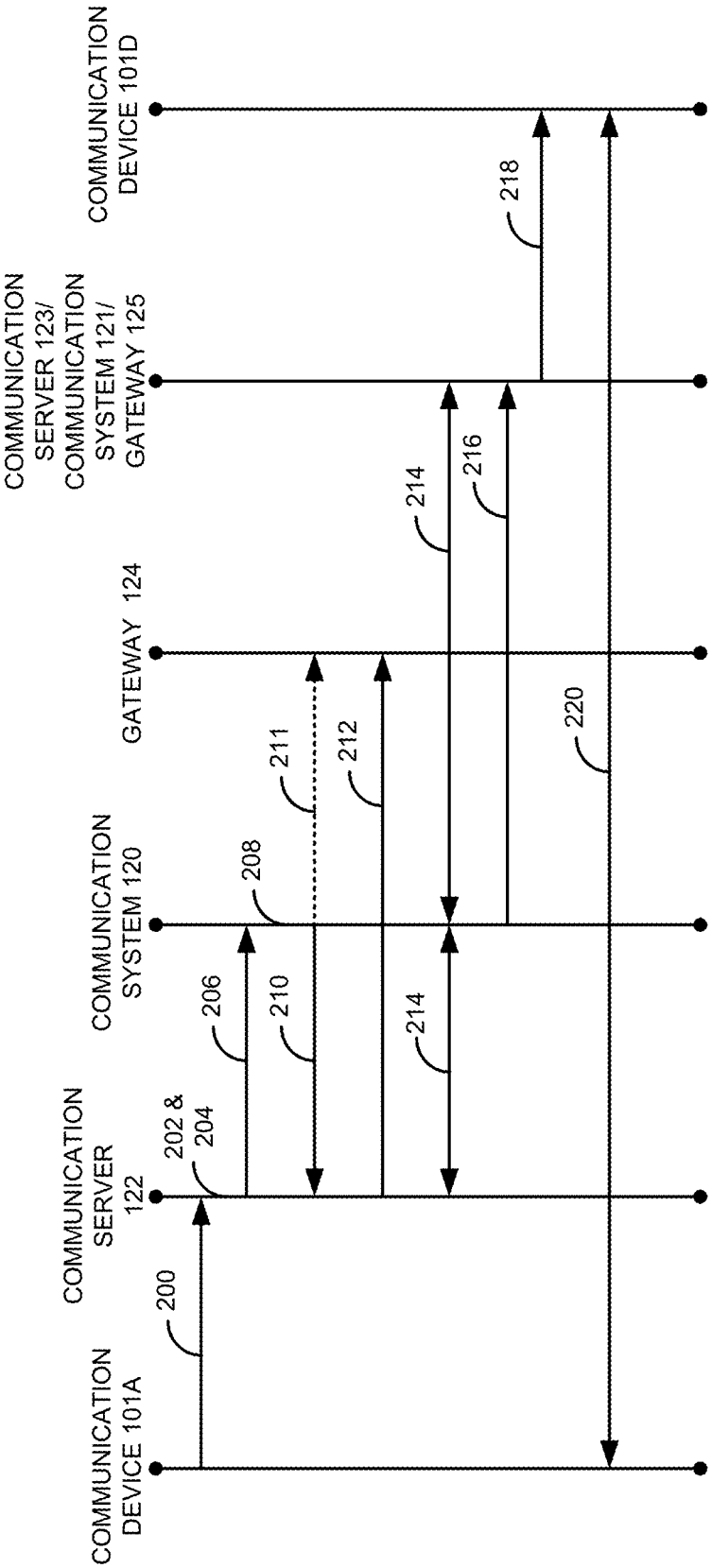
COMMUNICATION DEVICE 101A
COMMUNICATION SERVER 122
COMMUNICATION SYSTEM 120
GATEWAY 124
COMMUNICATION SERVER 123/ COMMUNICATION SYSTEM 121/ GATEWAY 125
COMMUNICATION DEVICE 101D
200
202 & 204
206
208
210
211
212
214
214
216
218
220

FIG. 2

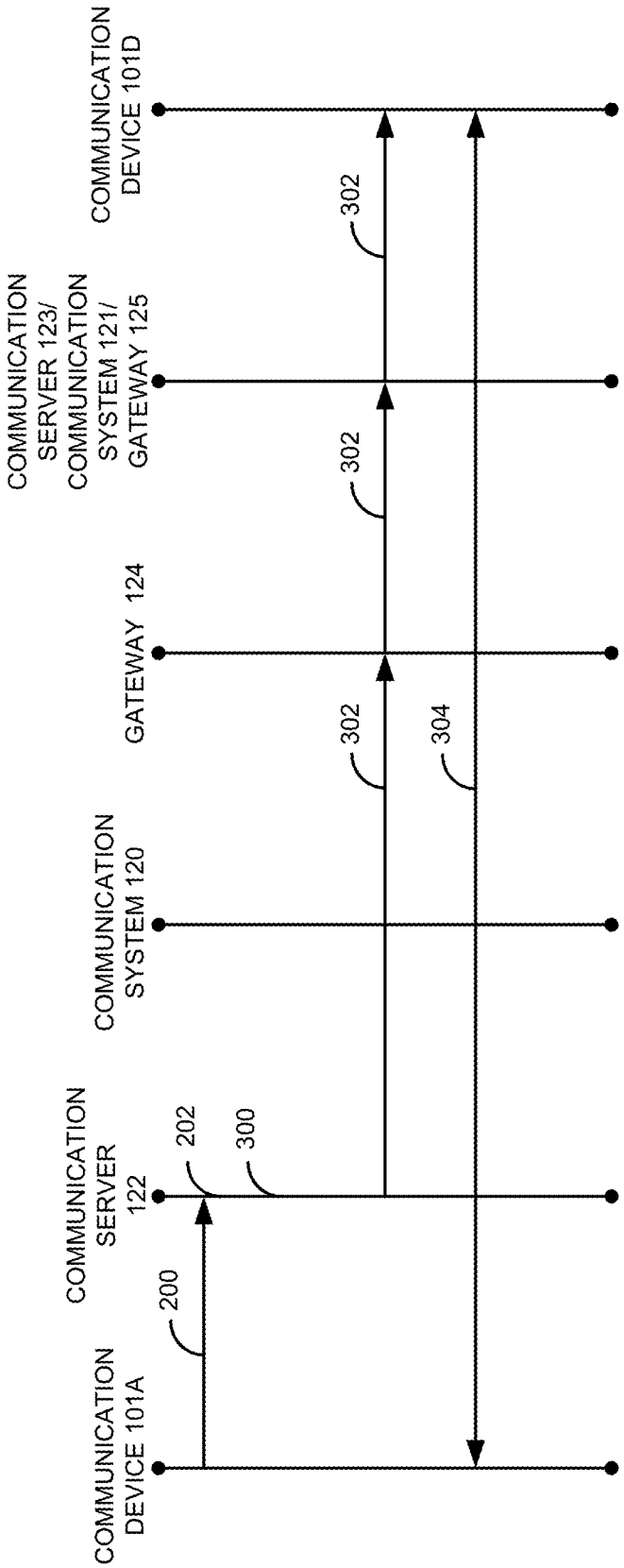
COMMUNICATION DEVICE 101A
COMMUNICATION SERVER 122
COMMUNICATION SYSTEM 120
GATEWAY 124
COMMUNICATION SERVER 123/ COMMUNICATION SYSTEM 121/ GATEWAY 125
COMMUNICATION DEVICE 101D
200
202
300
302
302
302
304

FIG. 3

COMMUNICATION FAILOVER IN A DISTRIBUTED NETWORK

RELATED U.S. PATENT APPLICATION DATA

This application claims the benefit under 35 U.S.C. §119 (e) of U.S. Provisional Application No. 61/817,028, filed Apr. 29, 2013 entitled "DPT IN THE DISTRIBUTED ARCHITECTURE REM ADDITIONS."

TECHNICAL FIELD

The systems and methods relate to network failover systems and in particular to network failover systems using different protocols.

BACKGROUND

There are a variety of systems that can fail over a communication from a primary network to a secondary network. This works well when there is a single centralized system in the network that manages all aspects of the communication system. When the primary network fails, the centralized system is able to route a communication to the secondary network without any problems.

However, when the network has been decentralized, the problem becomes more acute. In distributed networks such as Session Initiation Protocol (SIP) networks, functionality has been distributed between devices such as proxy servers and other communication systems. For example, a proxy server may handle the initial call processing and another communication system will handle call features, such as call forwarding (e.g., by using a Back-to-Back User Agent (B2B UA)). In these distributed environments, the proxy server and the other communication system need to be included in the process of directing the communication to a secondary network so that the call features can still operate in a failover situation.

SUMMARY

Systems and methods are provided to solve these and other problems and disadvantages of the prior art. An initial request is received from a communication device to establish a communication session. The initial request contains a communication address of a first communication device. A communication server or communication system detects that the communication session cannot be established across a primary network. In response, the initial request is repurposed by changing the first communication address to a second communication address. The changed request is sent to a communication system, which adds a field to the changed request that indicates that the changed request is to be sent via a secondary network. The changed request is sent with the field to the communication server. The changed request with the second communication address is sent to a gateway to establish the communication session across a secondary network. A portion of the communication session is established using the second communication address. The first communication address is sent in the portion of the communication session using Dual-Tone-Multi-Frequency (DTMF). The first communication address is used to complete the communication session from the second communication device to the first communication device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a first illustrative system for failing over a communication session in a distributed network.

FIG. **2** is a flow diagram of a method for failing over a communication session in a distributed network.

FIG. **3** is a flow diagram of a method for failing over a communication session in a distributed network.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of a first illustrative system **100** for failing over a communication session in a distributed network. The first illustrative system **100** comprises communication devices **101**A-**101**N, a primary network **110**, a secondary network **111**, communication systems **120** and **121**, communication servers **122** and **123**, and gateways **124** and **125**. In FIG. **1**, communication devices **101**A-**101**C are shown connecting to communication server **122** for illustrative purposes. Likewise communication devices **101**D-**101**N are shown connecting to communication server **123**. However, one of ordinary skill in the art would recognize that the communication devices **101**A-**101**N can be connected via a network that allows the communication devices **101**A-**101**N to connect with any of the communication systems **120**-**121**, the communication servers **122**-**123**, and the gateways **124**-**125** respectively.

The communication devices **101**A-**101**N may be any device that can communicate on the primary network **110** or the secondary network **111**, such as a Personal Computer (PC), a telephone, a video system, a cellular telephone, a Personal Digital Assistant (PDA), a tablet device, a notebook device, a voice server, a video server, a text messaging server, a voice mail system, and the like. As shown in FIG. **1**, any number of communication devices **101**A-**101**N may be connected to the networks **110** and **111**.

The primary network **110** and/or the secondary network **111** can be any network that can send and receive information, such as the Internet, a Wide Area Network (WAN), a Local Area Network (LAN), the Public Switched Telephone Network (PSTN), a packet switched network, a circuit switched network, a cellular network, an enterprise network, a corporate network, a combination of these, and the like. The primary network **110** can use a variety of protocols, such as Ethernet, Internet Protocol (IP), Session Initiation Protocol (SIP), H.323, Integrated Services Digital Network (ISDN), and the like. In one embodiment, the primary network **110** is a SIP network and the secondary network **111** is a PSTN network that uses Plain Old Telephone System (POTS) or ISDN.

The communication systems **120** and **121** can be any communication system that provides services for communications, such as a communication feature server, a JSR 289 server, and/or the like. For example, the communication systems **120** and **121** can be Avaya's Communication Manager™. The communication systems **120** and **121** can provide a variety of services, such as call forwarding, call recording, call screening, call center services, Interactive Voice Response (IVR) services, call transferring, and/or the like. The communication systems **120** and **121** can be a combined communication system. The communication systems **120** and **121** may use a variety of protocols, such as Session Initiation Protocol (SIP), H.323, Integrated Digital Services Network (ISDN), Asynchronous Transfer Mode (ATM), and/or the like.

The communication servers **122** and **123** can be a registrar, a proxy server, a SIP proxy server, a routing device, and/or the like. For example, the communication servers **122** and **123** can be Avaya's Session Manager™. The communication servers **122** and **123** can use a variety of protocols, such as Session Initiation Protocol (SIP), H.323, Integrated

Digital Services Network (ISDN), Asynchronous Transfer Mode (ATM), and/or the like.

The gateways **124** and **125** may be any device that can change one protocol to another protocol, such as a session border controller and the like. For example, the gateways **124** and **125** can converts SIP, ISDN, and/or H.323 to Plain Old Telephone System (POTS) in one direction and POTS to SIP, ISDN, and/or H.323 in the other direction.

In one embodiment, the communication device **101**A sends an initial request to establish a communication session with the communication device **101**D across the primary network **110**. The initial request comprises a communication address of the communication device **101**D. For example, the communications address of the communication device **101**D may be a telephone number of the communication device **101**D. However, in other embodiments, the communication address of the communication device **101**D may be another type of address, such as a network address, a device address, and/or the like. The communication session can be any type of communication session, such as a voice session, a text session, a video session, and/or the like.

The communication server **122** receives the initial request. The communication server **122** (and/or the communication system **120**) detects that the communication session across the primary network **110** cannot be established. The communication server **122** can detect that communication session cannot be established in various ways, such as, based on a packet time-out, based on receiving or not receiving a message, based on a status, and/or the like. In response to the communication server **122** detecting that the communication session across the primary network **110** cannot be established, the communication server **122** repurposes the initial request by changing the communication address of the communication device **101**D to a second communication address.

The changed request is repurposed because the communication session needs to use the second communication address in order to connect to the communication device **101**D. In this embodiment, in order to use the secondary network/complete the communication, the communication server **122** needs one or more services that are provided by the communication system that the communication server **122** does not support (e.g. to send the first communication address via Dual-Tone-Multi-Frequency (DTMF), B2B UA services, and/or the like).

The second communication address is an intermediary address that is used to establish a communication session using the secondary network **111**. The second communication address can be a Listed Directory Number (LDN) that is a designated telephone number (or address) for failover communications. The second communication address can be, depending on the protocol used, in different fields within a packet or header. The communication server **122** sends the changed request with the second communication address to the communication system **120**.

The communication system **120** receives the changed request. The communication system **120** adds a field that contains a parameter that indicates that the request is to be sent via the secondary network **111**. The field can be in any type of field, including a header, a payload, a Session Initiation Protocol (SIP) invocation attachment, an identifier, an addition to an existing field, a change of an existing field, and/or the like. The communication system **120** sends the changed request with the field to the communication server **122**. In response to receiving the changed request with the field, the communication server **122** recognizes that the request is to be sent via the secondary network **111** (based on the field that indicates that the request is to be sent via the secondary network **111**). The communication server **122** sends the changed request (with at least the second communication address) to the gateway **124**. The gateway **124** initiates establishment of a portion of the communication session, across the secondary network **111**, using the second communication address with the gateway **125**, the communication server **123**, and/or the communication system **121**.

Once the portion of the communication session is established, the communication system **120** sends the communication address of the communication device **101**D (that was in the changed request that the communication system **120** received) in the established communication session (i.e., in-band) using Dual-Tone-Multi-Frequency (DTMF) tones. The communication system **121** receives the DTMF tones with the communication address of the communication device **101**D. The communication address of the communication device **101**D is used to complete establishment of the communication session with the communication device **101**D.

To illustrate, consider the following example. A user at communication device **101**B makes a voice call to another user at communication device **101**N. The user at communication device **101**B has invoked a voice recording application (a Back-to-Back User Agent) that is running in communication system **120** to record all calls made to the user at communication device **101**N.

The user at communication device **101**B calls the user at communication device **101**N by dialing 303-538-1111 (the communication address of communication device **101**N). An initial SIP INVITE is sent to the communication server **122** (a SIP proxy server) to establish a SIP communication session across the primary network **110**. The communication server **122** detects that the communication session across the primary network **110** cannot be established.

In response to detecting that the communication session cannot be established across the primary network **110**, the communication server **122** repurposes the initial SIP INVITE by changing the communication address of the communication device **101**N (303-538-1111) with a second address (303-538-1000) that is a Listed Directory Number (LDN 303-538-1000) for the location of where the communication device **101**N is located. The LDN is a dedicated telephone number for failover conditions. The changed SIP INVITE may be in the following format: SIP: 3035381000@avaya.com;avaya-dpt-dest=303-538-1111 SIP/2.0.

The communication server **122** sends the changed SIP INVITE with the LDN to the communication system **120**. The communication system **120** adds a field that indicates that the SIP INVITE is to be sent via the secondary network **111**. For example, the SIP INVITE may be in the following format: SIP:3035381000@avaya.com;av-dpt-outgoing SIP/2.0. The "av-dpt-outgoing" portion of the SIP INVITE indicates that the SIP INVITE is to be sent via the secondary network **111**. The communication system **120** sends the changed SIP INVITE with the field to the communication server **122**. The communication server **122** (this could be a different communication server **122** than received the initial SIP INVITE) sends the changed request to establish a portion of the communication session using the second address to the gateway **124**. A communication session is established between the communication system **120** and the communication **121**.

The communication system **121** sends a pass code (e.g., five known DTMF digits) back to the communication system **120**. The pass code tells the communication system **120**

that it has hit the right termination point and is okay to send the first communication address (303-538-1111). In response to receiving the pass code, the communication system **120** sends the communication address of the communication device **101**N (303-538-1111) using DTMF tones to the communication system **121**. In response to receiving the communication address of the communication device **101**N, the communication system **121** completes the establishment of the communication session with the communication device **101**N. The two parties at communication devices **101**B and **101**N can now communicate with each other. The two parties are unaware of the failure of the primary network **110**.

In another embodiment, when the communication system **120** receives the changed request (e.g., the SIP: 3035381000@avaya.com;avaya-dpt-dest=303-538-1111 SIP/2.0 message), instead of adding the field, the communication system **120** sends the request directly to the gateway **124**. In this embodiment, the "avaya-dpt-dest" field is the field that contains the parameter that indicates that the changed request is to be sent via the secondary network **111**. When the communication system **120** sees the "avaya-dpt-dest" field, the communication system **120** knows to send the request to the gateway **124**. The above examples use a specific tag for the field that indicates that the request is to be sent via the secondary network **111**. However, in other embodiments, various types of different fields and/or tags may be used.

In another embodiment, where the secondary network **111** supports a protocol such as SIP, the communication system **120** can send the request directly to the secondary network **111**, thus bypassing the gateway **124**.

In one embodiment, the communication address of the communication device **101**N cannot be directly dialed from the secondary network **111** (e.g., the number is an unlisted extension). In this case, the above process overcomes the issue of not being able to directly dial the communication device **101**N by sending the communication address of the communication device **101**N using DTMF so that the communication session between communication devices **101**B and **101**N can be established seamlessly.

In another embodiment, the second address (e.g. the LDN) is a number that can be used as a regular number or as a number that supports the above described process. In order to distinguish between a failover communication and a regular communication, once the portion of the communication session has been established, the communication system **120** sends an identifier in the portion of the communication session using DTMF. The identifier is used by the communication system **121** to distinguish between a failover communication and a regular communication. If communication system **121** does not receive the identifier, the communication system **121** assumes that the communication session is a regular communication session. If the communication system **121** receives the identifier, the communication system **121** assumes that the communication session is a failover communication session.

In another embodiment, the identifier can be used to distinguish between different types of arriving communications. For example, instead of distinguishing between a failover communication session, the identifier can distinguish between different types of failover communications. For example, a voice, video, text communication, a specific set of users, an encrypted communication, and/or the like.

FIG. **2** is a flow diagram of a method for failing over a communication session in a distributed network. Illustratively, the communication devices **101**A-**101**N, the communication systems **121** and **122**, the communication servers **122** and **123**, and the gateways **124** and **125** are stored-program-controlled entities, such as a computer or processor, which performs the method of FIGS. **2-3** and the processes described herein by executing program instructions stored in a tangible computer readable storage medium, such as a memory or disk. Although the methods described in FIGS. **2-3** are shown in a specific order, one of skill in the art would recognize that the steps in FIGS. **2-3** may be implemented in different orders and/or be implemented in a multi-threaded environment. Moreover, various steps may be omitted or added based on implementation.

The process starts by the communication device **101**A sending **200** an initial request to establish a communication session with the communication device **101**D across the primary network **110** (i.e., the default is to route the initial request over the primary network **110**). The initial request comprises the communication address of the communication device **101**D (e.g., in a SIP TO: field). The communication server **122** detects **202** that the communication session across the primary network **110** cannot be established. In response to detecting that the communication session across the primary network **110** cannot be established, the communication server **122** repurposes **204** the initial request by changing the communication address of the communication device **101**D with a second communication address.

The communication server **122** sends **206** the changed request to communication system **120**. The communication system **120** adds **208** a field (e.g. changes a field) to the changed request that indicates that the changed request is to be sent via the secondary network **111**. The communication system **120** sends **210** the changed request with the field to the communication server **122**. The communication server **122** sends **212** the changed request (with at least the second communication address) to the gateway **124**. The gateway **124** (e.g. in combination with communication servers **122-123**, communications systems **120-121**, and/or gateway **125**) establishes **214** a portion of the communication session across the secondary network **111**. The communication system **120** sends **216** the communication address of the communication device **101**D using DTMF in the portion of the communication session. Communication system **121** completes establishment **218** of the communication session with the communication device **101**D using the communication address of communication device **101**D. The communication session between the communication devices **101**A and **101**D is now complete as shown in step **220**.

In another embodiment, the communication **121** will establish the communication session by sending a request to establish the communication with communication device **101**D by sending a request message to the communication server **123** to establish the communication session between communication devices **101**A and **101**B.

In an alternative embodiment, instead of the communication system **120** sending the changed request with the field in step **210** and the communication server **122** sending the changed request with the field to the gateway in step **212**, the communication system **120** can send **211** the changed request (with at least the second communication address) directly to the gateway **124**. In this embodiment, the changed request that is sent in step **206** contains the field that indicates that the changed request is to be sent via the secondary network **111** (e.g., the avaya-dpt-dest field described above).

FIG. **3** is a flow diagram of a method for failing over a communication session in a distributed network. The process starts by the communication device **101**A sending **200**

an initial request to establish a communication session with the communication device **101**D across the primary network **110**. The initial request comprises the communication address of the communication device **101**D. The communication server **122** detects **202** that the communication session across the primary network **110** cannot be established. In response to detecting that the communication session across the primary network **110** cannot be established, the communication server **122** determines **300** that the remote communication system (e.g., the communication server **123**, the communication system **121**, and the gateway **125**) related to the communication address of the communication device **101**D does not support the sending of the communication address of the communication device **101**D in the portion of the communication session using DTMF. The communication server **122** can determine that the remote communication system related to the communication address of the communication device **101**D does not support the sending of the communication address of the communication device **101**D in the portion of the communication session using DTMF in various ways, such as, based on an administration, based on not receiving a pass code or other indicator from the remote communication system (after following steps **200**-**214**), and/or the like.

In response to determining that the remote communication system related to the address of the communication device **101**A does not support the sending of the first communication address in the portion of the communication session using DTMF, the communication server **122** directly calls **302** the remote communication system on the secondary network **111** using the network address of communication device **101**D (assuming that the communication address of the communication device **101**D can be called directly via the secondary network **111**). A communication session is then established **304** between the communication device **101**A and the communication device **101**D.

In the above embodiments, the process only describes a single communication session between communication two communication devices **101**. However, in other embodiments, a communication session may involve multiple communication devices. For example, a conference call can be setup between communication devices **101**A-**101**N using the above processes. In addition, one of skill in the art would recognize that the processes described above can be implemented using any number of protocols, such as SIP, ISDN, H.322, POTS, and/or the like.

Of course, various changes and modifications to the illustrative embodiment described above will be apparent to those skilled in the art. These changes and modifications can be made without departing from the spirit and the scope of the system and method and without diminishing its attendant advantages. The following claims specify the scope of the invention. Those skilled in the art will appreciate that the features described above can be combined in various ways to form multiple variations of the invention. As a result, the invention is not limited to the specific embodiments described above, but only by the following claims and their equivalents.

What is claimed is:

1. A method comprising:

receiving an initial request, at a communication server, from a second communication device, to establish a communication session with a first communication device across a primary network, wherein the initial request comprises a first communication address of the first communication device;

detecting, in the communication server or a communication system, that the communication session across the primary network cannot be established;

in response to detecting that the communication session across the primary network cannot be established,

modifying, by the communication system or the communication server, a field to the changed request to contain a parameter that indicates that the changed request is to be sent via a secondary network, wherein the first communication address in the initial request is transformed to a second communication address in the changed request; and

sending, by the communication server, the changed request with at least the second communication address to a gateway to establish the communication session across the secondary network, wherein the gateway establishes a portion of the communication session using the second communication address

and sends the first communication address in the portion of the communication session using Dual-Tone-Multi-Frequency (DTMF).

2. The method of claim **1**, further comprising:

sending the changed request with the field to the communication server; and

completing establishment of the communication session with the second communication device using the first communication address.

3. The method of claim **1**, further comprising:

sending an identifier in the portion of the communication session using DTMF, wherein the identifier is used to distinguish between a failover communication and a regular communication.

4. The method of claim **1**, further comprising:

receiving a pass code; and

in response to receiving the pass code, sending the first communication address in the portion of the communication session using in-band signaling.

5. The method of claim **1**, wherein the second communication address is a designated address for failover communications.

6. The method of claim **1**, wherein the initial request to establish the communication session across the primary network is a Session Initiation Protocol (SIP) request and wherein the secondary network is a Public Switched Telephone Network.

7. The method of claim **1**, further comprising:

determining that a remote communication system related to the communication address of the first communication device does not support the sending of the first communication address in the portion of the communication session using DTMF; and

in response to determining that the remote communication system related to the communication address of the first communication device does not support the sending of the first communication address in the portion of the communication session using DTMF, directly calling the remote communication system on the secondary network using the first network address.

8. The method of claim **1**, wherein the first communication address cannot be directly dialed from the secondary network.

9. The method of claim **1**, wherein the primary network is an Integrated Digital Services Network (ISDN) or an H.323 network.

10. The method of claim **1**, wherein the initial request is a Session Initiation Protocol (SIP) INVITE and wherein the second address is in a SIP invocation attachment.

11. A system comprising:

a communication server that:

receives an initial request, from a second communication device, to establish a communication session with a first communication device across a primary network, wherein the initial request comprises a first communication address of the first communication device;

detects that the communication session across the primary network cannot be established;

causes the initial request to be transformed into a changed request, in the changed request the first communication address in the initial request is transformed to a second communication address in response to detecting that the communication session across the primary network cannot be established,

wherein the changed request contains a parameter that indicates that the changed request is to be sent via the secondary network; and

sends the changed request with at least the second communication address to a gateway to establish the communication session across a secondary network, wherein the gateway sends the first communication address in a portion of the communication session using Dual-Tone-Multi-Frequency (DTMF) and completes establishment of the communication session using the second communication address.

12. The system of claim 11, wherein the communication system completes establishment of the communication session with the second communication device using the first communication address.

13. The system of claim 11, wherein the communication system sends an identifier in the portion of the communication session using DTMF, wherein the identifier is used to distinguish between a failover communication and a regular communication.

14. The system of claim 11, wherein the communication system receives a pass code and in response to receiving the pass code, send the first communication address in the portion of the communication session using in-band signaling.

15. The system of claim 11, wherein the second communication address is a designated address for failover communications.

16. The system of claim 11, wherein the initial request to establish the communication session across the primary network is a Session Initiation Protocol (SIP) request and wherein the secondary network is a Public Switched Telephone Network.

17. The system of claim 11, wherein the communication system determines that a remote communication system related to the communication address of the first communication device does not support the sending of the first communication address in the portion of the communication session using DTMF and directly calls the remote communication system on the secondary network using the first network address in response to determining that the remote communication system related to the communication address of the first communication device does not support the sending of the first communication address in the portion of the communication session using DTMF.

18. The system of claim 11, wherein the primary network is an Integrated Digital Services Network (ISDN) or an H.323 network and wherein the first communication address cannot be directly dialed from the secondary network.

19. A gateway, comprising:

a processor that:

receives an initial request, from a second communication device, to establish a communication session with a first communication device across a primary network, wherein the initial request comprises a first communication address of the first communication device;

transmits the initial request to a communication server;

in response to a determination that the communication session across the primary network cannot be established, receives a changed request derived from the initial request, wherein the first communication address in the initial request is transformed to a second communication address in the changed request and wherein the changed request contains a parameter that indicates that the changed request is to be sent via the secondary network;

establishes a portion of the communication session;

sends the first communication address in the portion of the communication session using Dual-Tone-Multi-Frequency (DTMF) signaling; and

completes establishment of the communication session using the second communication address.

20. The gateway of claim 19, wherein the parameter in the changed request is an identifier, wherein the identifier distinguishes between a failover communication and a regular communication, wherein the gateway receives a pass code and, in response to receiving the pass code, sends the first communication address in the portion of the communication session using DTMF signaling, wherein the second communication address is a designated address for failover communications, wherein the initial request to establish the communication session across the primary network is a Session Initiation Protocol (SIP) request, and wherein the secondary network is a Public Switched Telephone Network.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,426,021 B2
APPLICATION NO. : 13/926963
DATED : August 23, 2016
INVENTOR(S) : Mendiratta et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims

Column 8, line 7, claim 1 delete "a field to" therein.

Signed and Sealed this
Sixth Day of December, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office